COMPOSTING SEAFOOD PROCESSING RESIDUALS IN MAINE

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Maine Department of Environmental Protection, Bureau of Remediation and Waste Management
Maine State Planning Office, Waste Management and Recycling Program

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I. Introduction

Maine's commercial fishing industry plays a significant role in the state's economy; accounting for roughly 3 to 5 percent of its total annual income. Increased competition for finite resources, development of stricter regulations on harvest volumes and fishing equipment, and having to cope with ever growing disposal costs all collectively impact this fragile industry. Traditionally, seafood residuals have been re-sold as lobster bait or distributed for use in fish meal production and pet food rendering. These outlets work well if the waste stream is steady and volumes are predictable.

However, seasonal fluctuations and last minute crises often overwhelm these facilities, creating the need for back-up options. Additionally, due to the putrescible and odorous nature of seafood residuals, there are very few disposal facilities willing to accept this product.

Composting provides a low tech, cost-effective option, which transforms a "waste" product into a beneficial soil amendment that is stable and odor free. However, composting seafood residuals requires diligent management to prevent problems with odors, leachate and animal (vector) attraction.

During the 1990s, Maine experienced a boom in the seafood composting industry going from two (2) licensed facilities in 1990 to 17 facilities in 1999. This growth in composting may be attributed to state mandated closure of municipal landfills, soaring disposal fees associated with Maine's privately operated landfills and fishing industry movement away from the environmentally costly practice of ocean disposal.

Currently, 19 facilities compost seafood residuals in Maine. The feedstocks composted include: fin fish cuttings (herring, dog fish, ground fish); shell fish (clams, scallops, mussels and whelks); and, crustaceans (lobsters, crabs and sea urchins). Each of these residuals poses a unique set of challenges.

All of Maine's facilities receive tipping fees which range from $20 to $30 dollars per ton on average. Maine's landfills currently charge $65 to $100 per ton, and ocean disposal costs up to $45 per ton. Even with the cost of trucking added, composting usually ends up being a better deal for most seafood processors.

A. Why do it ?

1. Lower Costs
Composting is a relatively inexpensive management method as compared to the cost of disposing the same materials at either landfills or incinerators. In addition, managing seafood waste through composting benefits us all by extending the limited life of in-state landfills, and by making the best use of expensive in -state incinerator capacity and technology.

2. Environmental Benefits
Diverting seafood processing residuals to composting sites reduces the potential for water and air pollution from landfills, and reduces air emissions, residue, and incinerator ash that must be landfilled as a special waste. The use of compost can improve soil quality, reduce water consumption in the landscape, and reduce non-point source pollution from the overuse of chemical fertilizers.

3. Improve public relations and education
Informing and educating citizens to the benefits of a properly managed and promoted community compost program is a readily accessible demonstration of "waste to resources" that positively engages the residents and businesses with tangible benefits back to the community.

4. Make a useful and desirable commodity
Composting turns waste materials into a valuable end product. Citizens, local businesses and public works departments can be both the suppliers of additional carbon and nitrogen feed stocks, and the end users of the compost.

B. Why now?

1. Composting has proven a track record throughout the State
While there is ongoing research to improve methods of composting and to expand the uses of compost, composting has been part of the Maine waste management scene for more than a decade. Composting has been promoted at the state level through a variety of grant programs that funded master composting training, home composting education and equipment, pilot and demonstration projects and community level leaf and yard trimming composting operations.

2. Composting has encouraging standing in regulation
In November of 1998, The Maine Department of Environmental Protection published the new Solid Waste Management Rules and Regulations. These provide a clear and consistent framework for environmentally sound compost operations.

3. Ready access to good technical assistance

In addition to knowledgeable staff at the Maine D.E.P and State Planning Office, Maine is home to two nationally known resources on composting: the **Compost Team** and the **Compost School**. Both programs are cooperative efforts by the Departments of Environmental Protection and Agriculture, the Maine State Planning Office, the Cooperative Extension Service of the University of Maine, and the University of Maine at Orono.

C. Seafood Composting Challenges

Even with all of its economic advantages, the process of siting, developing and managing a compost facility can be a very arduous experience. Seafood processors and compost facility operators have different needs and requirements that must be considered prior to setting up a compost site. Seafood processors operate on a limited budget and often have little or no on-site storage capacity.

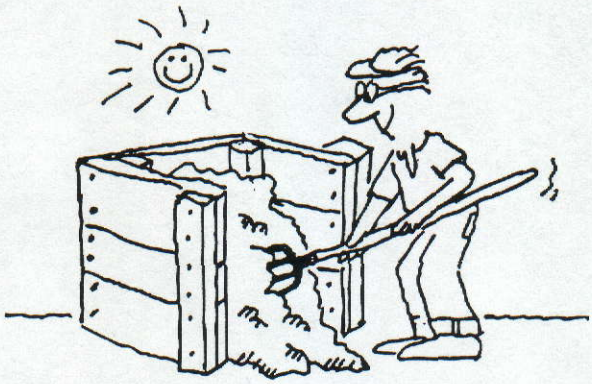
This creates an immediate problem, as seafood residuals by nature, tend to be highly putrescible and odorous due to a low carbon to nitrogen ratio (<15:1) and low solids content (10% to 30%). As a result, this residual tends to break down quickly, creating odor and leachate issues, necessitating the need for regular removal.

The compost site must be relatively close to the processing facility, as trucking seafood residuals long distances can be cost prohibitive. Additionally, processing facilities often cannot guarantee predictable waste volumes to compost facilities as the amount of waste generated depends on the catch success of the fishing vessels.

Therefore, compost facilities must be adequately sized to handle incoming waste streams and properly designed to facilitate flow of materials throughout the compost process. The compost facility must also have adequate amounts of carbon amendment on site to mix with incoming loads of seafood at proper, pre-determined compost recipes. This initial mixing helps to control leachate, prevent odors and initialize the compost process.

Most of Maine's seafood compost facilities depend on tipping fees to help establish and maintain their sites. This arrangement works well provided that compost facility operators accept only the volume of waste that the facility can handle. However, facility operators often accept more product than they can process in the hopes of expanding their sites with the added revenue. Invariably, this "short circuits" the compost process leading to numerous nuisance problems including: odors, leachate, and animal (vector) attraction.

Once a facility begins this downward spiral it is often difficult to recover. Additionally, compost facilities need to establish operating hours and access control to prevent unauthorized deliveries, especially on weekends when facility personnel are not available to properly process incoming loads. Dust, noise, and



II. The Compost Process

Composting is a biological process in which microorganisms consume organic materials (carbon and nitrogen compounds) and convert them into a nutrient-rich, humus-like product. Although composting can occur without oxygen, the composting presented in this guide is an aerobic process, meaning that the microorganisms require oxygen to live.

In order for the microbes to survive and multiply within a compost pile, in addition to oxygen, there must be suitable amounts of carbon, nitrogen, and moisture. The moisture serves as the medium in which the microorganisms live, the carbon provides the energy/food source to fuel them, and the nitrogen provides the building blocks for their reproduction. The composting process begins when the appropriate ratios of materials have been mixed together. The physical process of mixing usually provides enough oxygen to initiate the composting.

During the "active composting phase," the microorganisms consume a great deal of oxygen as they feed on the available organic matter. At the same time, they are producing heat, water vapor, and carbon dioxide as they consume and reduce the original volume and mass of the raw ingredients.

A "curing phase" usually follows the active phase. During curing, the microorganisms still feed, but at a slower pace, giving off lower amounts of heat, water vapor, and carbon dioxide. Left undisturbed, the microorganisms will continue to feed until all the organic matter has been consumed. The final product is a nutrient rich soil amendment that provides many benefits including: increased organic matter, enhanced soil structure, drainage and porosity, and water holding capacity. Because of these qualities, compost is a valuable end product for the local home gardener and landscape companies.

A. Four common composting techniques used in Maine

Over the years, many composting systems have been developed and employed in Maine to facilitate the composting process. Today, though, there are 4 fundamental composting systems in use: the static pile, the aerated static pile, the turned windrow, and the in - vessel system.

1. **The Static Pile.** Lisbon Transfer and Recycling Facility

The static pile method involves mixing the compost ingredients together and constructing a pile from the blended material. Subsequent turnings may not be required.

Advantages:

- The least labor/equipment intensive method.
- The preferred method for composting leaves.
- The only equipment needed is a tractor with a bucket or a front end loader(or a very strong back!)
- The pile may be turned up to 4 times a year but will usually compost without any further management.

Drawbacks:

- The composting usually happens very slowly due to the steady reduction in the amount of oxygen available throughout the pile.

Wilton Residuals Compost Facility

2. Aerated Static Pile. This system involves building a static pile on top of an aeration system, either passive (usually pipes with holes) or forced air, and then leaving the material without subsequent turning until the active phase of the compost process is completed. However, during this phase air is passively drawn or forced through the pile with fans or blowers.

Advantages:

- This low tech approach requires very little capital investment or accessory equipment and as a result, has been widely used for manure and municipal sewage residual composting efforts.

Drawbacks:

- Because there can be no mechanical turning of the pile once it is placed on the aeration system, a thorough mix of all materials must be achieved at the outset of the pile formation. Care must be taken to achieve a homogenous blend.
- Care must be taken in the layout of the aeration system to allow for the free exchange of air or else odors may occur.
- There must be careful monitoring of the airflow, temperature, and moisture content of these piles as they are prone to excessive drying, that can result in a slow down of the activity of the microbes.

Land & Sea Compost, Rockport

3. Turned Windrow System. This is the preferred method for most on-farm and seafood composting activities. It would work equally well for municipal operations with sufficient space and resources.
Typically, leaves and yard trimmings are placed down in layers in long piles (windrows) and mixed using a mechanical windrow turner. Windrows are then turned as needed with the same windrow turner. A front end loader can be substituted to mix and turn the windrows though care must be taken to achieve a good level of mixing. A front end loader will require more time than a windrow turner.

Advantages:

- The windrow system requires the least amount of time for the composting to occur and allows for a large volume of material to be turned in a short length of time.
- Each subsequent turn further blends the compost ingredients, releases trapped carbon dioxide and water vapor, redistributes air spaces within the row, and also aides in the physical breakdown of the materials. This results in a very uniform product.

Drawbacks:

- This method requires more intensive management and more space than the static pile/ aerated pile methods.
- Pile temperature must be carefully monitored so that the row will be turned at the appropriate time to ensure successful composting.
- Windrow turning machines can be costly investments.

Green Mountain Systems

4.

In-Vessel System. As the name denotes, in - vessel composting occurs within a closed system. Usually this means within a building or a container. All of the receiving, mixing, and composting activities are enclosed, and exhaust gases are collected and processed through a filter. Any leachate generated during composting is collected and recirculated back into the process.
Most in - vessel systems combine forced air and a form of mechanical mixing or agitation.

Advantages:

- The immediate benefit of in-vessel systems is the rapid production of a well decomposed product without any concern for odors or leachate generation.

Drawbacks:

- The initial capital investment can be prohibitive.
- Such systems use complex machinery which requires a high level of technical expertise to operate and maintain.

III. The Regulations

"In Maine, seafood residuals composting activities are regulated under the provisions of Maine Solid Waste Regulations, Chapter 409, "Procesing Facilities", Section *9-Reduced Procedure For Select Compost Facilities.* Each Activity requires a permit which may be obtained through any of the Department of Environmental Protection's Regional offices (a complete reference list of Department licensing staff phone numbers and regional office locations appears at the end of this document). **The following section lists the minimum siting and operating standards as excerpted from Chapter 409, Section 9:**

"A. Applicability. This section applies to compost facilities that choose to follow the siting, design and operational standards in this section and compost the following residuals:

(1) Any amount of type IA residuals; and/or

(2) Up to 400 yds^3 monthly of type IB residuals; and/or

(3) Up to 200 yds^3 monthly of type IC residuals; or up to 200 yds^3 monthly of type II residuals.

NOTE: See Chapter 400, section 1 for a full definition of residual types. Type IA residuals are leaf, vegetative and other residuals with a C:N ratio of greater than 25:1. Type IB residuals are food and other residuals with a C:N ratio of between 25:1 to 15:1. Type IC residuals are fish and other residuals with a C:N ratio of less than 15:1. C:N refers to the ratio of available carbon to nitrogen of the raw residual prior to composting. See appendix 409.A for a list of typical C:N ratios for various residuals. The lower the initial C:N the higher the potential for generation of nuisance odors. Type II residuals are sewage sludge, septage, and other residuals that may contain human pathogens. Type III residuals are petroleum contaminated soils and other residuals that may contain hazardous substances above risk based standards in Chapter 418, appendix A.

If these conditions are not met, or if the applicant chooses to site, design or operate the facility in a manner that would not meet the standards of this section, then the applicant must submit a formal application to the Department for a license to develop and operate the compost facility under sections 2-3. Facilities licensed under this section are subject to the operating standards in section 4.

B. Reduced Procedure Siting and Design Standards. In addition to the general siting and design standards contained in section 2, all compost facilities licensed under this section must comply with the following standards:

(1) Working surface: mixing, composting, curing, storing or otherwise handing residuals, and compost at the facility must be on surfaces meeting one of the following standards:

(a) On soils that a Maine certified soil scientist has determined are moderately well drained to well drained, as classified by the Natural Resources Conservation Service, and that are at least 24 inches above the water table, bedrock, and sand or gravel deposits.

(b) On a pad that is constructed a minimum of 2 feet above the seasonal high water table and is either composed of:

(i) a minimum of 18 inches of soil material having between 15 and 35% fines, covered with a minimal 6 inch drainage layer of compacted gravel; or

(ii) soil covered with asphalt or concrete.

(c) Alternative surface: on a surface determined by a soil scientist, soil engineer or other qualified individual as being suitable for the proposed activity, taking into account the other aspects of the facility design, such as a roofed structure or invessel system. An applicant must arrange a pre-application meeting with the Department if proposing an alternative surface under this section.

(2) Pad: At facilities handling type IC residuals, the applicant must construct a receiving and mixing pad covered with asphalt, concrete, or other impervious material. For facilities processing type II residuals, or more than 750 cubic yards of type IC residuals annually, the applicant must construct a pad covered with asphalt, concrete, or other impervious material for the entire waste handling area, excluding the storage area for compost having a dewars stability class of 4 or greater.

(3) Storm Water and Leachate Control: Surface water drainage must be diverted away from receiving, processing, composting, curing, and storage areas. The facility must also be designed to manage run-off and leachate to prevent contamination of groundwater or surface water. Water falling on the facility during a storm of an intensity up to a 25-year, 24 hour storm event must infiltrate or be detained such that the storm water rate of flow from the facility after construction does not exceed the rate prior to construction. The facility design must include provisions to contain, collect and treat any leachate generated at the facility.

(4) Slopes: Surfaces on which composting takes place must slope between 2% and 6%, and where necessary, be graded to prevent ponding of water.

C. **Operating Requirements.** In addition to the operating requirements of section 4, all compost facilities licensed under this section are subject to the following additional operating requirements. Except for facilities subject to section 8.A(2)(b), facilities licensed under the permit-by-rule provisions of former Chapter 567, section C-2.a (effective December 23, 1989) and whose licenses were in effect on November 2, 1998 are also subject to the operating requirements of section 4, and the following additional operating requirements:

(1) Pad Inspection: All soil surfaces that are used for residuals mixing and composting must annually be graded clean and re-compacted. All concrete and asphalt pads must annually be scraped clean and inspected for cracks or other deformities, and repaired as needed. The operator must maintain the minimum 2 foot separation to bedrock, groundwater and sand or gravel deposits.

(2) Odor Control: The facility must be operated to prevent nuisance odors at occupied buildings. The facility must:

(a) Operate and maintain the odor control system approved by the Department;

(b) Receive incoming putrescible residuals on a pile of sawdust or other sorbent, high carbon compost amendment;

(c) Contain and treat process air or cover odorous piles with a layer of finished compost or other suitable compost amendment;

(d) Properly aerate piles such that composting is aerobic throughout the pile;

(e) Blend materials to achieve a homogenous mix throughout the pile; and

(f) Alter the compost recipe as needed to alleviate odorous emissions.

(3) Pathogen treatment and vector attraction reduction: Type IC and Type II residuals must be composted to achieve a Class A Pathogen Reduction and Class A Vector Attraction Reduction in accordance with Chapter 419 , Part B-1.d, unless otherwise approved in the facility's utilization license issued under Chapter 419 or Chapter 567. To attain these standards by composting, all of the following standards must be met:

(a) Pathogen Reduction: Through the process of composting, each particle of residual is maintained at 55 degrees Celsius or higher for three consecutive days. For windrow systems, this standard is presumed to be met if the residual is maintained at operating conditions of 55 degrees Celsius or higher for 15 days or longer, and during the period when the compost is maintained at 55 degrees or higher, there is a minimum of five turnings of the compost pile.

(b) Vector Attraction Reduction: Residual must be treated by an aerobic composting process for 14 days or longer. During that time, the temperature of the residual must be higher than 40 degrees Celsius and the average temperature of the residual must be higher than 45 degrees Celsius.

(c) Analytical Standard: The density of *Salmonella sp.* bacteria in the finished compost must be less than three Most Probable Number per four grams of total solids (dry weight basis). In the absence of analytical data on *Salmonella sp.* this standard is presumed to have been met when the density of fecal coliform in the finished compost is shown to be less than 1000 Most Probable Number per gram of total solids (dry weight basis). This analytical standard must be met at the time the compost is utilized.

(4) Static Pile composting: The following additional standards apply to composting type IC or type II residuals using the static pile method:

(a) the static piles must be aerated during the active composting stage;

(b) detention time in the static aerated pile must be at least 21 days;

(c) unless an auger, tub grinder hammer mill, or other Departmentally approved mixer is used to mix the initial ingredients for the pile, the pile must be broken down half way through the active compost process and reformed.

(d) the pile must be maintained with an insulating blanket of at least 12 inches of finished compost, sawdust, or other material as approved by the Department during the active compost phase to maintain temperatures throughout the pile and control odors.

(5) Stability: Residuals that have completed the active composting phase must also be cured until the equivalent of a dewar's stability class of IV or greater is achieved, unless otherwise approved in the facility's utilization license issued under Chapter 419.

(6) An operations log must be kept at the facility and made available for Department review during normal business hours containing the following:

(a) source and volume of residual received on a daily basis;

(b) date of individual pile construction and breakdown;

(c) pile composition (mixture recipe);

(d) date and time of turning or otherwise aerating;

(e) process monitoring data;

(f) date the pile is put into curing and the date it is taken out of curing; and

(g) date, time and type of samples obtained from the facility

(7) The facility may not receive more than the volumes in section 9.A.

(8) Residuals must be handled on approved surfaces. Type IC and type II residuals must be offloaded and mixed on a receiving pad meeting the standards in section 9.B(2).

D. **Application Requirements.** The applicant shall submit to the Department, on forms developed by the Department, information sufficient to meet the standards and submissions requirements of Chapter 400, section 4 and the application requirements of section 3 of this Chapter. For outdoor compost facilities, instead of the subsurface investigation information required by section 3.H, the applicant may submit a report from a Maine Certified Soil Scientist or other qualified individual that either:

(1) Verifies that the waste handling areas for the proposed facility are on soils that are moderately well drained to well drained, as classified by the Natural Resources

IV. MAKING COMPOST

A. Setting Up

Once the site has passed initial inspection by the DEP, it is time to begin setting it up. The first consideration involves determining how large a footprint you will need to handle the volumes that you project. Remember, it is a lot easier to fill vacant space than it is to create more space at an already cramped site!

Determining the footprint is generally accomplished by developing a site-layout plan. (See Appendix H for a sample site-layout plan.)

A site layout plan should sub-divide the compost area into designated handling areas, list facility design features, and facilitate materials flow through the process. It will show you how many times the same material will have to be handled and the how long it will take up space in the different management areas on the site.

The following section describes a typical site-layout plan; an illustration depicting this site-layout immediately follows:

- Receiving and Handling Area: Allows for the coordinated delivery and handling of in-coming feedstocks. Problem residuals may be isolated here. Provides operators with their first chance to control odors through good residual management (i.e., receiving putrescible materials, such as manure, on a bed of sawdust or leaves to help absorb leachate) and immediate mixing of seafood processing residuals with carbonaceous amendment .

- Amendment Storage Area: Allows delivery and stockpiling of carbonaceous amendment, free from contamination with other feedstock.

- Mixing Area: Allows pre-determined, measured amounts of feedstocks to be accurately and thoroughly mixed, while also providing for odor and leachate control. A thorough, heterogeneous mixture facilitates initiation of the active compost phase.

- Composting Area: This is the point where active composting begins. This is generally the largest portion of the site and should be located central to the receiving/handling and mixing areas.

- Curing Area: This area is designed for aging and final maturation of compost piles that have completed the active compost phase. Curing is an essential step in the completion of the compost process, allowing natural progression and die-off of microbial populations.

Waste Bypass Area: Provides a centralized area for collection and storage of "non-compostables" for later disposal. Rejected loads of residuals may be staged here while waiting for pick-up. Common contaminants may include:

- Road grit and sand;
- Litter, coffee cups and lunch bags;
- Rocks, roots, and dirt;
- Large branches, and waste wood;
- Plastic bags, plant containers, and flower pots.

B. THE WORKING SURFACE

Upon determining the footprint of the compost area, you will need to develop a suitable work surface. A flat surface with a 2 to 4% grade allows surface precipitation to quickly move off the pad, which prevents ponding. There has been much discussion regarding the benefits/need of an asphalt or concrete pad over a traditional compact gravel or soil-based pad. Proponents of the asphalt pad claim that it provides an impervious barrier, preventing leachate movement to groundwater. In addition, asphalt and concrete pads are very durable and can withstand years of use with very little maintenance. Soil and gravel pads, on the other hand, are prone to leachate infiltration and associated rutting, needing to be scraped and resurfaced on a yearly basis. For leaf and yard trimming composting, a compacted gravel pad is adequate, as very little leachate is usually generated as a result of composting these feedstocks. However, if you are considering co-composting your leaf and yard trimmings with manure or food discards, you may wish to consider investing in an asphalt or concrete pad to avoid future leachate issues.

Compost facility design should include provisions for site drainage. Every attempt should be made to divert surface run-on (clean water) away from the compost area. This can usually be accomplished using upslope diversion ditches or berms. In areas where surrounding water sheds are significant, stone-lined waterways and catch basins may be employed to intercept and channel surface water. Compost piles may be protected from precipitation by using pile coverings such as polar fleece to help shed excess water. Roofing over the compost operation is an option if the very high cost can be justified by the scale and goals of the program.

Runoff from the compost pad may be intercepted and treated by placing a vegetated "level lip spreader"on the downslope edge of the composting surface (Check with your county Natural Resources Conservation Service office for advice on design and placement of level lip spreaders, or refer to the technical assistance list at the end of this document.)

Facility access roads should also be designed and constructed with site drainage considerations in mind. Run-on from surrounding slopes can be diverted from the compost site simply by constructing a perimeter road perpendicular to the surrounding slopes.

C. SITE OPERATIONS AND MANAGEMENT

The general operations of a compost facility can be broken down into six separate steps:

- recipe development;
- feedstock preparation;
- mixing and pile formation;
- turning;
- curing.

1. RECIPE DEVELOPMENT

The first step to beginning any compost effort is to determine what feedstocks are available for use and at what ratios they should be blended together. The easiest way to accomplish this is to develop a compost recipe. As a general rule, for leaf and yard trimmings, a recipe of three parts leaves to one part grass clippings will yield satisfactory results. If manure is added to the mixture, at least two additional parts leaves should be added for each part manure.

Taking recipe development further:
In a more detailed and comprehensive approach, each compost feedstock is representatively sampled and sent to a testing laboratory to be analyzed for:

- %moisture,
- total nitrogen,
- ammonia,
- total carbon,
- volatile solids,
- bulk density,
- pH.

A final mixture (recipe), which optimizes the chances for aerobic, thermophilic composting (sustained temperatures greater than 131 degrees Fahrenheit) is developed.
In order for microbial colonization to occur, a recipe must contain appropriate amounts of carbon (microbial energy source), nitrogen (provides building blocks for microbial replication) and moisture (the medium that the microbes live in). In addition, there must be enough coarseness to the ingredients to promote natural diffusion of air throughout the final mixture. Otherwise, anaerobic conditions producing odors will occur. The following conditions must be met, within the recipe, in order for optimal composting conditions to occur:

- moisture-50 to 60%,
- Carbon to Nitrogen Ratio (C:N)-20:1 to 30:1,
- pH 6.5 to 7.5,
- Bulk Density <1,000 lbs./cubic yard and
- volatile solids >40% dry weight basis.

For assistance in developing individual recipes, please refer to the technical assistance reference list that appears at the end of this document.

2. FEEDSTOCK PREPARATION OPTIONS

Once you have determined your compost recipe, you should consider preparing the feedstocks for the mixing process. The amount of time you invest in initial feedstock preparation directly affects the rate at which your materials will compost. Your goal is to create a feedstock that can be handled easily but will decompose quickly. The first processing step usually involves material sizing through grinding. Grinding feedstocks prior to mixing increases available surface area for microbial contact, provides for a better mixture among ingredients and helps to speed decomposition by initiating the physical breakdown of ingredients. The purchase or lease of a grinder can be a costly investment, but grinding services can be hired in Maine on a per day basis. The charge for this service usually consists of the cost of transportation, set up, and the grinding. Grinding should be considered when making up the facility's operations budget.

Tub grinder, Glowood Farm, Yarmouth

Once the feedstocks have been properly sized, the next consideration is moisture management. Ideally, a feedstock should contain approximately 50% to 60% water. Adding water to a dry feedstock will help optimize conditions for microbial colonization, whereas adding dry material to a saturated pile helps to create additional air spaces for pile oxygenation. To address this issue, your facility should have a water supply contingency plan, or if possible, have water directly available on site so that feedstocks and compost piles may be irrigated if necessary.

3. MIXING AND PILE FORMATION

a. Mixing. Next to recipe development, proper mixing is the single most important step determining success or failure of the compost operation. Obtaining a thorough, homogeneous mixture at the onset of the compost process, will ensure intimate contact between the carbon, nitrogen and moisture components of the pile, thereby reducing the potential for the formation of "dead spots". In addition, proper mixing allows for even air distribution throughout the pile, helping to promote aerobic composting.

Front End Loader, Boothbay District

Manure Spreader, Lee Farm, Edgecomb

Mixer-Wilton Compost Facility

Windrow Turner, Land & Sea Compost, Rockport

Mixing can be accomplished by using: front-end loaders, manure spreaders or other farm equipment, batch or continuous mixers, and windrow turners. Regardless of the method chosen, the objective is to obtain as thorough a mix as possible to help hasten the onset of the active composting phase.

b. Pile Formation. The objective here is to create a pile large enough to sustain the "self-heating" process that accompanies active, thermophilic (requiring high temperature) composting. As a general rule, piles should be constructed at least five to six feet high by eight to 15 feet in diameter. In areas experiencing long winter seasons, pile dimensions may need to be increased to 10 feet high by 15 to 18 feet in diameter. The size and shape of the compost pile will ultimately be determined by the type of compost system that you choose and the volume of material you will be handling in a given season. In addition to adequate mass, the pile must also contain enough porosity (air spaces) to allow natural movement of air throughout the pile. Creating piles that are too high (in excess of 10 feet) risks compression of the inner core contents due to the excessive weight of the overlying materials.

4. TURNING

Turning is the physical process by which compost pile ingredients are blended and re-mixed throughout the active compost phase to help sustain thermophilic temperatures. During the turning process, compacted, settled materials are "fluffed-up", creating air spaces. The act of turning accomplishes several things at once, including: re-mixing of pile ingredients, further physical breakdown of resistant ingredients, and redistribution of air spaces within the pile to help promote passive air flow. In addition, the turning process can be used as a moisture management tool. Piles that are too wet can be turned more often to facilitate drying, whereas piles that are too dry may be turned immediately following precipitation events to help capture and retain moisture. In addition, flattening the top of a pile prior to an anticipated rain event increases the amount of surface area available to absorb moisture.
The frequency of turning depends upon the individual needs of each compost pile.

The easiest way to track the performance of your pile and determine the need for subsequent turnings, is to take and record daily pile temperatures.
To accomplish this, two readings should be taken for each sampling site, one reading at one foot within the pile and the other at three feet or the pile core itself. These readings should be compared, and compost piles should be turned whenever the difference

exceeds 20 degrees. By following this plan, declining temperature trends may be caught and corrected through turning, before pile temperature crashes occur. As a rule of thumb, piles should also be turned whenever there is a significant drop in temperature that cannot be accounted for by an external cause (i.e., 100 year storm event), when active composting temperatures exceed 150 degrees Fahrenheit, or when significant odor production suggests pile imbalances. Piles should not be turned so frequently that the compost process is interrupted and not allowed to reach the optimum temperature.

Wildcat Turner, Windham Corrections Facility

5. CURING

Once the compost mixture has completed the active compost phase, it must undergo a sustained period of curing. Curing is an important, and often forgotten, phase of the compost process. During curing, microorganisms continue the process of organic matter degradation (concentrating on organic acids, large particles, resistant compounds and other particles remaining after the active compost phase), but at a much slower, limited rate. Oxygen consumption, heat generation, carbon dioxide and water vapor evolution are all decreased as the material "matures".

Curing is also essential in readying your product for market. Prolonged curing can make up for compost process shortcomings while also preventing the inadvertent distribution of an immature product. An immature compost product can potentially damage plant root systems due to the presence of volatile organic acids, high C:N ratios, high salt contents, or simply by competing with soil microbes or plant roots for available oxygen reserves.

Once you have a reasonably mature product, you may wish to begin immediate distribution. Some facilities opt to screen the finished compost as a final processing step. Screening improves product quality by removing contaminants and other large, uncomposted particles from the finished product. Screening provides a uniform product

that is aesthetically pleasing and therefore, has increased value. The costs involved, including capital investment and extra labor, often deter facility managers from choosing this option. In fact, if you take the time to properly inspect the feedstocks, removing contaminants prior to mixing, the screening step will often not be necessary. Regardless, whether to screen or not is an individual decision dictated by the needs of your community and consumers of the compost product.

V. TROUBLE SHOOTING THE COMPOST PROCESS

No matter how well you operate your facility you are invariably going to experience nuisance problems from time to time. Nuisance problems are the number one complaint about compost facilities. Engineering and technology to correct these problems can be expensive and ineffectual. The key to remember is that these are "people problems" and that prolonged nuisance conditions can lead to facility shutdown. Complaints should be met with an immediate response, including an explanation of the cause, if known. Good siting can help avoid potential nuisances by ensuring that you have adequate buffers to neighboring residences. Remember, many people "smell" with their eyes. Valleys and gullies should be avoided whenever possible, as they can carry nuisance odors to neighboring residences. Access roads should be located away from residences, maximizing the use of existing visual screens (tree buffers). However, there is no substitute for proper site management. Most problems are often interrelated and as a result, addressing one usually solves the others. The key to overcoming nuisance problems is to identify the "root" cause and correcting it. **The trick to remember is that most compost problems can be avoided simply by optimizing the compost recipe (40-60% moisture, 6.5-7.5 pH, 20:1 to 30:1 C:N, homogeneous mixture, and adequate "air spaces" within the piles) at the onset of composting.**

The following section describes the most common nuisance problems associated with seafood compost facilities and methods that have been developed to correct them. A condensed Trouble Shooting table immediately follows this section.

Odors: Odors signify a breakdown in the compost process. Left uncorrected, odors can drift off site impacting neighboring residences. Odor issues can be addressed by paying strict attention to process control. Incoming loads of seafood residuals should be immediately mixed with carbon amendment as soon as they are received. This is the first chance to control odors. If this is not possible, materials should be received in waterproof, airtight containers until they can be processed. Initial compost recipes should be thoroughly mixed, and the following parameters should be optimized: C:N (25:1 to 30:1), porosity (adequate air space distribution) and % moisture (45% to 60%). Finally, compost piles may also be covered with a 10 to 15 centimeter layer of sawdust, peat or finished compost to act as an odor scrubber.

Vectors: Vectors are organisms capable of transmitting diseases to humans. These organisms include birds (sea gulls and crows), mammals (rats and other rodents) and flies. They are attracted to odorous, decaying materials, especially pieces of marine organisms that have not been properly incorporated into compost piles. Vectors can be discouraged by maintaining a neat and clean operation. Grinding seafood residuals also allows for better compatibility with amendments during mixing; making the waste

products less odorous and therefore, less attractive. In addition, thoroughly cleaning empty storage vessels also reduces attractiveness to vectors.

Leachate: Leachate results from poor moisture management during initial recipe formation and/or from prolonged exposure of compost windrows to heavy precipitation. As mentioned above, initial compost recipes should have a moisture content of 45 to 60%. Because leachate contains concentrated nutrients, it poses a significant threat to groundwater. In addition, if your piles are losing nutrients than your finished compost will be poorer in quality. There are several approaches to leachate management. The first is to prevent it. Leachate can be avoided by achieving proper mix ratios at the onset of composting. Additionally, composting under a roofed structure or by using water resistant covering materials can help minimize the effects of precipitation on leachate generation. Most Maine facilities try to capture the leachate by amending it with sawdust or other suitable materials and then re-incorporating it back into the compost piles. Other facilities collect the leachate into a storage tank and then reuse it on the piles when moisture adjustments are necessary. Finally, leachate may be discharged onto a level vegetated surface for treatment. The key to leachate control is to manage moisture in the initial recipe development.

Dust, Noise and Traffic: All of these problems are often interrelated. Dust is created as a result of many compost facility operations including: materials off-loading, mixing, compost turning, screening and traffic. Dust conditions can also be exacerbated by prevailing winds, carrying particles onto neighboring properties. On site, dust can be an irritant to facility workers affecting the eyes and respiratory tract. Noise from compost equipment such as front-end loaders, grinders, mixers, transport trucks and compost turners can annoy neighbors directly abutting your facility. Increased traffic results in noise, dust, excessive speeds and bottlenecks. These issues can be addressed by developing daily operating hours, monitoring equipment noise, setting speed limits on access roads and soliciting feedback from your neighbors. In addition, dust conditions can be minimized by moistening dry compost piles and enclosing screening, mixing and turning operations.

PROBLEM	CAUSE	SOLUTION
Piles fail to heat	Pile too wet or too dry	Adjust moisture to 40-60%
	pH too low or too high	Adjust pH to 6.5-7.5
	Mix is not uniform	Breakdown and re-mix piles; grind ingredients to make compatible
	Particle size is too small	Add "bulking" source to pile to increase porosity
	C:N too high	Adjust C:N to 20:1 - 30:1
	Pile mass too small	Combine piles to increase mass
"Uneven" compost temperatures	Mix is not uniform; particle size mismatch	Breakdown and re-mix piles; grind ingredients to make compatible
Odor Production		
Ammonia	pH too high (>8.5)	Lower pH to 7.5
	Pile too dry	Raise pile moisture to 40%
	Too much nitrogen in recipe	Add carbon source until C:N is between 20:1 and 30:1
"Pungent-Rotting Smell"	pH too low (<5.5)	Raise pH up to 6.5
	Pile too moist	Dry pile down to 60% moisture
	Poor Pile Porosity	Re-mix pile to increase porosity and/or add more bulking agents
Failure to produce a stabilized finished product	Compost pile has not completed active compost phase	Re-mix pile, adjust recipe and allow to continue composting until active phase has been completed
	Inadequate "curing" time	Allow pile to cure for additional time-up to 6 months if necessary

VI. Your Community and Other Challenges

Fostering and maintaining good relations with the community surrounding your compost site begins before the production of any compost and should be part of the operations plan developed prior to start up.

A. YOUR STRATEGY:

- Take advantage of local media and use local public forums, such as Kiwanis, Lions and Rotary clubs to promote what you want to do.
- Talk about composting and compost; demonstrate your knowledge of the uses and applications of compost.
- Briefly describe the operations with a focus on the quality control.
- Detail a plan for getting this information out to potential local users: including municipal public works departments or road crews, public garden and landscape projects, school departments, general contractors, loam production contractors, private homeowners and local landscape contractors.
- You should also consider having the compost tested for its soil amendment value and to ensure the material poses no threat to plants or humans.
- Be up front and answer people's questions and concerns. Address such potential issues as odor, noise, and environmental safeguards.
- Consider sponsoring a backyard home composting workshop to familiarize residents with the process and its benefits.
- Look for opportunities to donate compost to local projects. Such actions will create good will and advertise your product.

Boothbay Regional Refuse Disposal District

B. COMPOSTING IN MAINE

Operating a compost facility in Maine can offer many challenges to the beginning facility manager. Seasonal fluctuations in weather conditions as well as seasonal availability of feedstocks requires preplanning and site preparedness. In the spring, heavy rains can saturate piles, halting compost activity, while rendering access roads impassable. Likewise, sudden winter storms can paralyze a facility by freezing compost piles and halting compost activities.The key is to develop and stick with a successful operating plan that accounts for these weather factors.

C. WINTER COMPOSTING

Maine winters are notorious for being long and cold. Accumulations of snow and ice, coupled with extended periods of subzero temperatures, can spell disaster for outdoor (exposed) facilities if caught unprepared. Excessive snow must be removed and access ways kept open to allow continued facility operations. Cold temperatures slow the

compost process by increasing the amount of heat lost by the compost pile. As this continues, pile microorganisms slow down their metabolic activity, further exaggerating the heat loss, which may result in complete halting of compost activity.

Prior to the onset of colder weather, composting piles may be combined to increase mass (to retain heat) and prevent freeze-ups. As a general rule, finished piles should be at least five feet high by 10 feet wide to assure enough mass to sustain thermophilic temperatures throughout the winter season. Piles (windrows) may also be covered with a commercially available pile cover. The covers, manufactured from a wide variety of materials, help insulate compost piles by preventing heat loss and cold infiltration. In addition, the covers shed water further protecting the pile's surface from freezing. Even if the piles do freeze, it is important to remember that this is only a temporary condition and that the compost process will take off again once the piles thaw.

Spring composting provides additional challenges to facility operators. Periods of heavy rains and slow ground thawing may result in pad rutting and site accessibility issues. This problem can be avoided by designing and constructing an impervious composting surface as well as planning for durable year-round access during the site selection and development phase.

D. SEASONAL AVAILABILITY OF FEEDSTOCKS

Many composting feedstocks are available on a seasonal basis. Leaves, for example, are collected primarily in the fall and to a lesser degree during spring clean up. They must be composted in large quantities. Facilities must develop contingency plans to make allowances for this sudden influx. Seasonal feedstocks will require additional storage as well as adequate space for their immediate processing. Some facilities may wish to compost on a "seasonal basis", operating only when the feedstocks are available. This method works well for small communities who save a portion of space at the local transfer station to handle incoming leaves in the fall.

VII. For Communities

According to the latest Maine Waste Management and Recycling Plan (June 1998) 140 communities have instituted bans on the disposal of leaves and yard trimmings with their municipal solid waste. Currently, there are 35 centralized municipal leaf and yard waste programs in operation in Maine. We hope this guide will stimulate more towns to consider the composting option.

We encourage programs that have established successful track records in managing leaf and yard trimmings to think about taking their composting programs to the next stage and adding other source separated organics to their mix. Good examples would be certain kinds of food wastes and fish processing wastes. Food discards comprise as much as 25% of the residential waste stream as compared to 13-14% for leaf and yard trimmings. Such a move would require additional regulatory review and monitoring, but would provide an alternative management option at a potentially lower cost than other disposal methods currently available. For more information on composting these and other materials, please see Appendix A (Technical Assistance.)

Appendix A

TECHNICAL ASSISTANCE :Statewide

The following Maine professionals offer composting technical assistance to individuals wishing to develop compost facilities:

Technical Assistance.

Mark King: Environmental Specialist, Team Leader for the **Maine Compost School**
Maine Department of Environmental Protection
Bureau of Remediation and Waste Management
Solid Waste Division.
17 State House Station, Augusta, ME 04333
Tel. (207) 287-2430
Pager (207) 287-3237
Fax (207) 287-7826
E mail: Mark.a.King@state.me.us

George MacDonald: Program Manager,
Maine State Planning Office
Waste Management and Recycling Program
38 State House Station, Augusta, ME 04333-0038
Tel. (207) 287-5759
Fax (207) 287-5756
E mail: George.MacDonald@state.me.us

Sam Morris: Senior Planner
Maine State Planning Office
Waste Management and Recycling Program
38 State House Station, Augusta, ME 04333-0038
Tel. (207) 287-8054
Fax (207) 287-5756
E mail: sam.morris@state.me.us

Dr. Bill Seekins: Composting and By-product Utilization Specialist,
Maine Department of Agriculture, Food, and Rural Resources
Office of Agricultural, Natural, and Rural Resources
28 State House Station, Augusta, ME 04333
Tel. (207) 287-1132
Fax (207) 287-7548/5576
E mail: Bill.Seekins@state.me.us

Richard Verville: Extension Educator
University of Maine Cooperative Extension
Kennbec County Office
125 State St., 3rd Floor, Augusta, ME 04330-5692
Tel. (207)622-7546
1-800-287-1481 (in Maine)
Fax (207) 621-4919
E mail: dickv@umce.umext.maine.edu

Maine Compost School
University of Maine Cooperative Extension
Waste Management Office
5741 Libby Hall, Room 116, Orono, ME 04469-5741
(207) 581-2722 or 1-800-287-0274 (in Maine)
Fax: (207) 581-1387
E-mail: nhallee@umext.maine.edu

DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Remediation & Waste Management
17 State House Station
Augusta, ME 04333-0017
Phone: 207-287-7688 OR 1-800-452-1942
Fax: 287-7826

Solid Waste Facilities Regulation*
Paula M. Clark
Phone: 207-287-2651
E-mail: paula.m.clark@state.me.us

Augusta Region
Jim S. Glasgow
Phone: 207-287-7719
E-mail: jim.s.glasgow@state.me.us

Bangor Region
Cynthia Darling
Phone: 207-941-4570
E-mail: cyndi.w.darling@state.me.us

Portland Region
Randy McMullin
Phone: 207-822-6300
E-mail: randy.l.mcmullin@state.me.us

Presque Isle Region
Lou S. Pizzuti
Phone: 207-764-0477
E-mail: lou.s.pizzuti@state.me.us

Policy & Procedures for Solid Waste Issues
Cliff Eliason
Phone: 207-287-2651
E-mail: clif.g.eliason@state.me.us

Hazardous Waste, Biomedical & Waste Oil Facilities Licensing
Stacy Ladner
Phone: 207-287-2651
E-mail: stacy.a.ladner@state.me.us

Composting
Mark King
Phone: 207-287-2430
E-mail: mark.a.king@state.me.us

TECHNICAL ASSISTANCE: Regional

Androscoggin Region.
Ferg Lea: Senior Planner,
Carol Fuller: Environmental Planner,
Androscoggin Valley Council of Governments
125 Manley Road
Auburn, ME 04210
Tel. (207) 783-9186
Fax (207) 783-5211
E mail:flea@avcog.org
E mail: cfuller@avcog.org

Hancock County.

Thomas Martin: Executive Director,
Jef Fitzgerald: Planner,
Hancock County Planning Commission
395 State Street, Ellsworth, ME 04605
Tel. (207) 667-7131
Fax (207) 667-2099
E mail: tomm@acadia.net
E mail: jef@acadia.net

Kennebec Region.
Sarah Flaks: Environmental Planner,
Kennebec Valley Council of Governments
17 Main St. Fairfield, ME 04937
Tel. (207) 453-4258
Fax (207) 453-4264
E mail: sflaks@kvcog.eddmaine.org

Penobscot, Piscataquis, Knox, Hancock, and Washington Counties.
Greg Lounder: Environmental Planner/ Staff for the Municipal Review Committee,
Eastern Maine Development Corp.
PO Box 2579
Tel. (207) 942-6389
Fax (207)942-3548
E mail: glounder@emdc.org

Aroostook County:
Jay Kamm: Environmental Planner,
Nothern Maine Development Commission
PO Box 779 Caribou, ME 04736
Tel. (207) 498-8736
Fax (207) 493- 3108
E mail: jkamm@nmdc.org

Portland Region:
Tony Dater: Environmental Planner,
Greater Portland Council of Governments
233 Oxford St. Portland, ME 04101
Tel. (207) 774-9891
Fax (207) 774-7149
E mail: tdater@gpcog.eddmaine.org

Southern Maine:
Kate Albert: Environmental Planner,

Southern Maine Regional Planning Commission
PO Box Q, Sandford, ME 04073
Tel. (207) 324-2952
Fax (207) 324-2958
E mail: tork@ime.net

Additional Assistance for Maine's Island Communities:
Susie Valaitis: Community Services Department,
Island Institute
410 Main St., Rockland, ME 04841
Tel. (207) 594-9209
Fax (207) 594-9314
E mail: svalaitis@islandinstitute.org

Appendix B UNIVERSITY OF MAINE COOPERATIVE EXTENSION (UMCE)

Administrative Offices
5741 Libby Hall
Orono, ME 04469-5741
Phone: 207-581-3188 OR 1-800-287-0274 (in Maine)
Fax: 207-581-1387

County Offices

Androscoggin and Sagadahoc Counties
133 Western Ave.
Auburn, ME 04210-4927
Phone: 207-786-0376 OR 1-800-287-1458
Fax: 1-800-924-7508
E-mail: andsag@umext.maine.edu

Aroostook County Offices
13 Hall St.
Fort Kent, ME 04743-1126
Phone: 207-834-3905 OR 1-800-287-1421
Fax: 207-834-3906
E-mail: cesnas@umext.maine.edu

Houlton Road
PO Box 727
Presque Isle, ME 04769-0727
Phone: 207-764-3361 OR 1-800-287-1462
Fax: 207-764-3362
E-mail: cescas@umext.maine.edu

Central Building
PO Box 8
Houlton, ME 04730-0008
Phone: 207-532-6548 OR 1-800-287-1462
Fax: 207-532-6549
E-mail: cessas@umext.maine.edu

Cumberland County
PO Box 9300
15 Chamberlain Ave.
Portland, ME 04104-9300
Phone: 207-780-4205 OR 1-800-287-1471
Fax: 207-780-4382
E-mail: cescmb@umext.maine.edu

Knox and Lincoln Counties
235 Jefferson St.
PO Box 309
Waldoboro, ME 04572-0309
Phone: 207-832-0343 OR 1-800-244-2104
Fax: 207-832-0377
E-mail: ceskl@umext.maine.edu

Oxford County
9 Olson Road
South Paris, ME 04281-6402
Phone: 207-743-6329 OR 1-800-287-1482
Fax: 207-743-0373
E-mail: cesox@umext.maine.edu

Penobscot County
307 Maine Ave.
Bangor, ME 04401-4331
Phone: 207-942-7396 OR 1-800-287-1485
Fax: 207-942-7537
E-mail: cespen@umext.maine.edu

Piscataquis County
59 E. Main St.
Dover-Foxcroft, ME 04426-1396
Phone: 207-564-3301 OR 1-800-287-1491
Fax: 1-800-287-1491
E-mail: cespsq@umext.maine.edu

Somerset County
Norridgewock Ave.
RR1, Box 4734
Skowhegan, ME 04976-9734
Phone: 207-474-9622 OR 1-800-287-1495
Fax: 207-474-0374
E-mail: cessom@umext.maine.edu

Franklin County
145A Main St.
Farmington, ME 04938-1729
Phone: 207-778-4650 OR 1-800-287-1478
Fax: 1-800-287-1478
E-mail: cesfrk@umext.maine.edu

Hancock County
63 Boggy Brook Road
Ellsworth, ME 04605-9540
Phone: 207-667-8212 OR 1-800-287-1479
Fax: 207-667-2003
E-mail: ceshnk@umext.maine.edu

Kennebec County
125 State St., 3rd Floor
Augusta, ME 04330-5692
Phone: 207-622-7546 OR 1-800-287-1481
Fax: 207-621-4919
E-mail: cesken@umext.maine.edu

Waldo County
RR4, Box 4645
Belfast, ME 04915-9627
Phone: 207-342-5971 OR 1-800-287-1426
Fax: 1-800-924-4909
E-mail: ceswal@umext.maine.edu

Washington County
11 Water St.
Machias, ME 04654-1017
Phone: 207-255-3345 OR 1-800-287-1542
Fax: 207-355-6118
E-mail: ceswsh@umext.maine.edu

York County
RR2, Box 1678
Sanford, ME 04073-9502
Phone: 207-324-2814 OR 1-800-287-1535
Fax: 207-324-0817
E-mail: cesyrk@umext.maine.edu

Appendix C Publications

Composting for Municipalities, Planning and Design Considerations
Editor: Mark Dougherty. Natural Resource, Agriculture and Engineering Service, 152 Riley - Robb Hall, Cooperative Extension, Ithaca, NY. 14853-5701. 1998, 126 pages (NRAES publication #94)

The Art and Science of Composting
Editied by the Staff of Biocycle. JG Press, Emmaus, Pennsylvania. 1991. 270 pages.

Yard Waste Composting
Editied by the staff of Biocycle. JG Press, Emmaus, Pennsylvania, 1989. 197 pages.

On Farm Composting Handbook
Editor: Robert Rink. Natural Resource, Agriculture, and Engineering Service, 152 Riley - Robb Hall, Cooperative Extension, Ithaca, NY 14853-5701 1992. 186 pages. (NRAES publication #54)

Municipal Leaf and Yard Waste Composting
Coordinated by Nancy E. Adams. University of New Hampshire Cooperative Extension, PO Box 200 Epping, NH 03042. 1993. 44 pages. *Heavily Appended, includes glossary.*

Keep It Off the Curb
Harmonious Technologies. PO Box 1865, Ojai, CA 93024. 1994. 218 pages.
A manual for managing a home compost program.

Field Guide to On-Farm Composting
Editor: Mark Dougherty. Natural Resource, Agriculture, and Engineering Service, Cooperative Extension 152 Riley-Robb Hall, Ithaca, New York 14853-5701 1999. 118 pages. (NRAES publication #114)
Field Guide format, plastic coated pages.

Appendix D

Useful Web Site Links

The University of Maine Cooperative Extension Compost School *www.composting.org*

Cornell Composting: *www.cals.cornell.edu/dept/compost*

The U.S. Composting Council *www.compostingcouncil.org*

The Composting Council of Canada *www.compost.org*

Composting: EPA *www.epa.gov/epaoswer/non-hw/compost/index.h™*

Food Waste Reduction: *www.epa.gov/epaoswer/non-hw/reduce/food/food.h™*

Waste Management and Recycling Program, Maine State Planning Office *www.state.me.us/spo/wm&r/wmhome.h™*

California Integrated Waste Management Board *www.ciwmb.ca.gov/organics*

The Compost Resource Page *www.oldgrowth.org/compost/*

The University of Maine Cooperative Extension www.umext.maine.edu/

Appendix E

Journals

Biocycle: Journal of Composting and Recycling
JG Press, 419 Sate St. Emmaus, PA 18049 (610)967-4135
E mail: Biocycle@aol.com
http://grn.com/grn/news/home/biocycle

Composting News
13727 Holland Rd. Cleveland, OH 44142 (216) 362-7979
http://ourworld.compuserve.com/

Appendix F

Laboratory Testing Services

Woods End Research Laboratory
Old Rome Rd. Rt. 2 Box 1850,
Mt. Vernon, ME 04352; (207) 293-2457 / fax(207) 293-2488
Email: wbrinton@woodsend.org also info@woodsend.org
Www.maine.com/woodsend.

Contact your local Cooperative Extension Office

Licensed Compost Facilities

COMPANY NAME	STATUS:	LOCATION	DESCRIPTION:	ADDRESS	TELEPHONE	ATS ID	LIC TYPE
ACTON, TOWN OF	Active	ACTON	WINDROW: LEAF AND YARD WASTE	BOX 540, ACTON, ME 04001-	(207)636-3839	15182	TYPE IA
AROOSTOOK RESEARCH FARM MAFES	Active	PRESQUE ISLE	PBR FOR COMPOSTING	59 HOULTON RD, PRESQUE ISLE, ME 04769-	(207)762-8281	30320	
AUGUSTA, CITY OF	Active	AUGUSTA	WINDROW: LEAVES AND FOOD	16 CONY STREET, AUGUSTA, ME 04330-	(207)626-2365	14716	TYPE IA
BALDWIN, TOWN OF	Active	BALDWIN	WINDROW: LEAVES	PO BOX 49, WEST BALDWIN, ME 04091-	(207)625-3581	14822	TYPE IA
BANGOR WWTP	Inactive	BANGOR	STATIC AERATED PILE: SEWAGE SLUDGE	760 MAIN ST, BANGOR, ME 04401-	(207)945-4400	20410	TYPE II
BAR HARBOR WWTP	Active	BAR HARBOR	STATIC AERATED PILE: SEWAGE SLUDGE AT HULLS COVE COMPOST FACILITY	P O BOX 337, BAR HARBOR, ME 04609-0337	(207)288-4098	23909	
BARTLETT FARM SERVICES INC	Active	ELIOT	INDOOR WINDROW: BONE GEL, PAPER, YARDWASTE	66 BRIXHAM ROAD, ELIOT, ME 03903-	(207)439-3083	15047	
BATSON, ELLIOTT	Inactive	ADDISON	WINDROW: SEAFOOD AND FISH	RR #1, BOX 252, ADDISON, ME 04606-	(207)483-4081	24605	
BELGRADE, TOWN OF	Active	BELGRADE	WINDROW: LEAVES AND VEGETATIVE WASTE	RR #1 BOX 912, BELGRADE, ME 04917-	(207)495-2258	24479	TYPE IA
BLUE RIBBON SEAFOODS INC	Active	LAMOINE	WINDROW: SEAFOOD WASTE AND MIXED PAPER	243 MAIN ST, BAR HARBOR, ME 04609-1744	(207)667-2162	15617	
BOOTHBAY REGION REFUSE DD	Active	BOOTHBAY	WINDROW: LEAF AND YARD WASTE	PO BOX 105, BOOTHBAY, ME 04537-	(207)633-5006	14128	TYPE IA
BRUNSWICK, TOWN OF	Active	BRUNSWICK	WINDROW: LEAF AND YARD WASTE	INDUSTRY ROAD, BRUNSWICK, ME 04011-	(207)725-6654	14843	TYPE IA
BUCKSPORT, TOWN OF	Active	BUCKSPORT	WINDROW: LEAF/YARD WASTE	P.O. DRAWER X, BUCKSPORT, ME 04416-	(207)469-7368	15484	TYPE IA
CHERRYFIELD FOODS, INC.	Active	CHERRYFIELD	WINDROW: FOOD WASTE	P.O. BOX 128, CHERRYFIELD, ME 04622-	(207)546-7573	15561	
CHICK ORCHARDS	Active	MONMOUTH	WINDROW: APPLE POMACE, HEN MANURE, LEAVES, AND WOODASH	BOX 157, MONMOUTH, ME 04259-0157	(207)933-4452	15541	TYPE IA
CORRECTIONS, DEPARTMENT OF	Active	WINDHAM	WINDROW: FOOD WASTES	P O BOX 260, WINDHAM, ME 04062-0260	(207)892-6716	15467	
COZY HARBOR SEAFOOD, INC.	Active	HOLLIS	WINDROW: COOKED SHRIMP SHELLS	P.O. BOX 389 DTS, PORTLAND, ME 04112-	(207)799-6595	15125	
CROSSROAD FARM	Active	JONESPORT	WINDROW: FISH PROCESSING WASTE	RFD BOX 3230, JONESPORT, ME 04649-	(207)497-2641	24006	

DECOSTER EGG FARMS	Inactive	TURNER	WINDROW: EGG WASTE	P.O. BOX 219-220, TURNER, ME 04282-	(207)224-8222	14869	
DENNIS KING	Active	PENOBSCOT	PBR FOR COMPOSTING TYPE I & IA MATERIAL WINDROW METHOD	RR 1 BOX 731, PENOBSCOT, ME 04476-	(207)326-9701	30888	
DOUG GOTT AND SONS INC	Active	TREMONT	WINDROW: CRAB PROCESSING WASTE AND SAWDUST	HCR 33 BOX 320, SOUTHWEST HARBOR, ME 04679-	(207)244-7461	24021	
DUBOIS LIVESTOCK	Active	BIDDEFORD	WINDROW: FISH WASTE & HORSE MANURE	23 IRVING RD, ARUNDEL, ME 04046-	(207)282-0323	30528	
ELIOT, TOWN OF	Active	ELIOT	WINDROW: LEAVE, GRASS AND GARDEN WASTES	141 STATE ROAD, ELIOT, ME 03903-	(207)439-9451	24022	
EMR INC	Active	SOUTHWEST HARBOR	WINDROWS: CRAB WASTE	PO BOX 787, SOUTHWEST HARBOR, ME 04679-078	(207)244-9033	24393	
FITZPATRICK, DONALD	Active	HOULTON	PBR COMPOST SITE TYPE I CULLED POTATOES	RFD 1 BOX 332, HOULTON, ME 04730-	(207)532-7508	28248	
FORT FAIRFIELD, TOWN OF	Active	FORT FAIRFIELD	WINDROW: CULL POTATOES, SLUDGE, AND FOOD WASTE	PO BOX 350, FORT FAIRFIELD, ME 04742-	(207)472-3800	15056	
GAMMON LANDSCAPE NURSERY INC	Inactive	AUBURN	WINDROW: VEGETATIVE WASTES	RFD 3, BOX 811 RT 4, AUBURN, ME 04210-	(207)783-6986	14743	TYPE IA
GARDINER WWTP	Inactive	GARDINER	STATIC AERATED COMPOST PILE	6 CHURCH STREET, GARDINER, ME 04345-	(207)582-1351	20418	TYPE II
GLOWOOD FARM	Active	YARMOUTH	WINDROW: SEAFOOD WASTE AND PRODUCE WASTE	670 NORTH RD, YARMOUTH, ME 04096-	(207)846-5041	14904	
GUPTILL & HUNTLEY	Active	WHITING	WINDROW: FISH WASTE	PO BOX 226, EAST MACHIAS, ME 04630-	(207)255-4130	27702	
H SMITH PACKING CORPORATION	Active	WESTFIELD	WINDROW: CULL POTATOES/SAWDUST/COVER MATERIAL/ASH	PO BOX 189, BLAINE, ME 04734-	(207)425-3421	15075	
HALFORD, JOYCE	Active	HARTLAND	TYPE IA COMPOSTING FACILITY-OPEN WINDROW	RFD 1 BOX 1890, HARTLAND, ME 04943-	(207)938-2336	29776	TYPE IA
HAWK RIDGE COMPOST FACILITY	Active	UNITY TWP	INVESSEL COMPOST FACILITY: SEWAGE SLUDGE	RFD 1 BOX 1682, UNITY, ME 04988-1682	(207)846-3737	14363	
HILLSIDE FARM	Inactive	CAMDEN	WINDROW: LEAF & VEGETATIVE WASTE	P.O. BOX 399, CAMDEN, ME 04843-		14864	TYPE IA
HOLM, KENNETH	Active	WHITEFIELD	WINDROW: LEAF/YARD WASTES	RR 1 BOX 121, WHITEFIELD, ME 04353-	(207)549-3263	23537	
HOULTON, TOWN OF	Active	HOULTON	WINDROW LEAF AND YARD AND CULL POTATOES	21 WATER ST, HOULTON, ME 04730-	(207)532-1325	26786	
INTERSTATE SEPTIC SYSTEMS INC	Active	ROCKLAND	AGITATED BIN: SEPTAGE, FOOD, FISH	10 GORDON DR, ROCKLAND, ME 04841-	(207)354-6310	15293	
J & L COMPOST	Active	WASHINGTON	WINDROW: FISH AND SEAFOOD PROCESSING WASTE	224 CRYSTAL LAKE ROAD, WASHINGTON, ME 04574-	(207)845-2391	24618	
JAY, TOWN OF	Active	JAY	WINDROW: LEAF AND YARD WASTE	99 MAIN STREET, JAY, ME 04239-	(207)897-6785	15239	TYPE IA
KENNEBUNKPORT WWTP	Active	KENNEBUNKPORT	STATIC AERATED PILE: SEWAGE SLUDGE & ASH	PO BOX 1038, KENNEBUNKPORT, ME 04046-0566	(207)967-4243	20412	

KINGFIELD, TOWN OF	Active	KINGFIELD	COMPOST LEAVES, GRASS, GARDEN WASTE: STATIC PILE	RR 1 BOX 1585, KINGFIELD, ME 04947-	(207)265-4637	27723	TYPE IA
KITTERY, TOWN OF	Active	KITTERY	WINDROW: LEAF AND YARD WASTE	PO BOX 808, KITTERY, ME 03904-0808	(207)439-4646	23369	TYPE IA
KNOX RIDGE HOLSTEIN FARM	Active	THORNDIKE	WINDROW: FOOD WASTE	RR 2, BOX 740, THORNDIKE, ME 04986-	(207)568-3683	26505	
LAND & SEA COMPOST	Active	ROCKPORT	WINDROW FACILITY/LEAF, YARD WASTE, FISH & MANURE	62 MEADOW ST, ROCKPORT, ME 04856-	(207)236-4147	29059	TYPE IA
LEWISTON-AUBURN W.P.C.A.	Active	AUBURN	AGITATED BIN: SEWAGE SLUDGE	535 LINCOLN ST, LEWISTON, ME 04240-	(207)782-0917	15150	
LINCOLN COUNTY SW MGT OFFICE	Active	NOBLEBORO	WINDROW: LEAF & YARD WASTE AND ANIMAL MANURE	PO BOX 249, WISCASSET, ME 04578-		15129	TYPE IA
LINCOLN SANITARY DISTRICT	Active	LINCOLN	AERATED STATIC PILE: SEWAGE SLUDGE	PO BOX 56, LINCOLN, ME 04457-	(207)794-8244	14438	
LITTLE RIVER TURF FARM	Active	LISBON	STATIC AERATED FACILITY: SEWAGE SLUDGE & AMENDMENTS	P O BOX 148, LISBON FALLS, ME 04252-	(207)353-2810	28670	
LITTLETON, TOWN OF	Active	MONTICELLO	WINDROW: LEAF & YARD, POTATOES	RR 1 BOX 70, MONTICELLO, ME 04760-	(207)538-9862	28149	
MACHIAS WWTP	Inactive	MACHIAS	WINDROW: SEWAGE SLUDGE	LOWER MAIN STREET, MACHIAS, ME 04654-	(207)255-3295	13379	TYPE II
MAINE WILD BLUEBERRY COMPANY	Active	MACHIAS	WINDROW: BLUBERRY WASTE AND FISH WASTE	P O BOX 128, CHERRYFIELD, ME 04622-0128	(207)255-8364	15287	
MAINE-LY POULTRY	Active	WARREN	BELTSVILLE METHOD: TURKEY OFFAL	PO BOX 5, WARREN, ME 04864-	(207)273-4029	15601	
MANCHESTER, NORRIS	Active	MACHIAS	WINDROW COMPOSTING: FISH SCALES & TYPE IC (200 YD3/YR)	RFD 1 BOX 297, MACHIAS, ME 04654-	(207)255-8732	31292	
MEARL CORPORATION	Inactive	PERRY	WINDROW: FISH SCALES	BROAD COVE, EASTPORT, ME 04631-	(207)853-2501	14408	
MID MAINE SOLID WASTE ASSOC	Active	CORINNA	WINDROW: LEAF & YARDWASTE	PO BOX 68, DEXTER, ME 04930-	(207)924-3650	27246	TYPE IA
MILLINOCKET, TOWN OF	Active	MILLINOCKET	WINDROW: LEAF AND YARD WASTE	197 PENOBSCOT AVENUE, MILLINOCKET, ME 04462-	(207)723-9701	15461	TYPE IA
MOORE, DAVID	Inactive	SWANVILLE	ROOFED WINDROW: SEPTAGE WITH WOODCHIPS	RFD 2 BOX 276, BELFAST, ME 04915-	(207)338-4586	24099	TYPE II
NEWCOMB, GREGORY S	Active	PERRY	PBR WINDROW COMPOSTING:FISH SCALES	BOX 148 SOUTH MEADOW RD, PERRY, ME 04667-	(207)853-4851	30325	
NEWPORT, TOWN OF	Active	NEWPORT	TYPE 1A COMPOST FACILITY	31 WATER ST, NEWPORT, ME 04953-	(207)368-5575	27895	
NORTH ATLANTIC PRODUCTS INC	Surrendered	THOMASTON	WINDROW: FISH SCALES AND PROCESSING WASTE-N. ATLANTIC PRODUCT	PO BOX 146, ROCKLAND, ME 04841-	(207)596-0331	14404	
NORTHERN KATAHDIN VALLEY WASTE	Active	DYER BROOK	TURNED PILE: YARD AND LEAF WASTE	RR #1, BOX 56, ISLAND FALLS, ME 04747-	(207)757-8700	25925	TYPE IA
OAKLAND, TOWN OF	Active	OAKLAND	WINDROW: LEAF AND YARD WASTE	P.O. BOX 187, OAKLAND, ME 04963-	(207)465-7357	25837	TYPE IA

OLD ORCHARD BEACH, TOWN OF	Active	OLD ORCHARD BEACH	STATIC AERATED PILE: SEWAGE SLUDGE RENEWAL	P O BOX O, OLD ORCHARD BEACH, ME 04064-	(207)934-5714	13562	
OLD TOWN WWTP	Active	OLD TOWN	STATIC AERATED PILE: SEWAGE SLUDGE	51 NORTH BRUNSWICK ST, OLD TOWN, ME 04468-1497	(207)827-3961	24420	
OLD TOWN, CITY OF	Active	PENOBSCOT	LEAF & YARD WASTE COMPOST- WINDROW METHOD	51 NORTH BRUNSWICK ST, OLD TOWN, ME 04468-	(207)827-3974	28678	TYPE IA
PENOBSCOT FROZEN FOODS INC	Active	WASHBURN	WINDROW: FOOD WASTE	P.O. BOX 229, BELFAST, ME 04915-	(207)338-4360	15596	
PLEASANT RIDGE LANDSCAPE NURSERY	Never Built	TURNER	WINDROW: LEAF AND YARD WASTE	R.R. 2, BOX 1312, TURNER, ME 04282-	(207)897-4062	15445	TYPE IA
PORTLAND WATER DISTRICT	Inactive	WESTBROOK	WINDROW: SEWAGE SLUDGE	P.O. BOX 3553, PORTLAND, ME 04104-	(207)761-8300	14230	TYPE II
PRESQUE ISLE, CITY OF	Active	PRESQUE ISLE	WINDROW: FOOD WASTE	12 2ND ST, PRESQUE ISLE, ME 04769-2459	(207)764-4485	24130	
REGIONAL WASTE SYSTEMS	Active	SOUTH PORTLAND	WINDROW: LEAF AND YARD WASTE	64 BLUEBERRY ROAD, PORTLAND, ME 04102-	(207)773-6465	14500	TYPE IA
RICKER FARM	Active	LISBON	WINDROW: LEAVES, VEGETATIVE, AND FOOD WASTE	60 RIDGE STREET, LISBON, ME 04250-	(207)353-4513	24159	TYPE IA
RID INC	Active	WEST BATH	WINDROW: LEAF AND VEGETATIVE WASTE	PO BOX 221, BATH, ME 04530-	(207)443-3217	15036	TYPE IA
ROBINSON MANUFACTURING COMPANY	Active	OXFORD	WINDROW: WOOL (TEXTILE) SLUDGE	PO BOX 195, OXFORD, ME 04270-	(207)539-4481	14698	
RUMFORD-MEXICO SEWERAGE DIST	Active	MEXICO	STATIC AERATED PILE: SEWAGE SLUDGE	P.O. BOX 160, RUMFORD, ME 04276-	(207)364-7225	13547	
RUSSELL, STEVEN C & ETHELYN B	Active	WINSLOW	WINDROW: LEAVES AND HEN MANURE	RFD #2, BOX 5890, WINSLOW, ME 04901-	(207)872-5758	24897	TYPE IA
SACO PUBLIC WORKS DEPARTMENT	Active	SACO	WINDROW: LEAF AND YARD WASTE	300 MAIN STREET, SACO, ME 04072-1583	(207)282-8209	14796	TYPE IA
SCARBOROUGH SANITARY DISTRICT	Active	SCARBOROUGH	STATIC AERATED PILE: SEWAGE SLUDGE	415 BLACK POINT ROAD, SCARBOROUGH, ME 04074-	(207)883-4663	13522	
SCOVILLE, TIMOTHY R	Active	LUBEC	OPEN WINDROW COMPOSTING: FISH WASTE	RD 2 BOX 1135, LUBEC, ME 04652-	(207)733-2351	31218	
SKOWHEGAN, TOWN OF	Inactive	SKOWHEGAN	WINDROW: LEAF AND FOOD WASTE	90 WATER ST, SKOWHEGAN, ME 04976-	(207)474-6911	26852	TYPE IA
SOIL PREPARATION INC	Active	PLYMOUTH	AGITATED BIN: SEPTAGE, SLUDGE, FOOD WASTE	P O BOX 158, PLYMOUTH, ME 04969-0158	(207)848-5405	26016	
SOUTH BERWICK, TOWN OF	Active	SOUTH BERWICK	WINDROW: LEAF AND YARD WASTE	180 MAIN STREET, SOUTH BERWICK, ME 03908-0236	(207)384-2263	24250	TYPE IA
SOUTH PORTLAND, CITY OF	Inactive	SOUTH PORTLAND	STATIC AERATED PILE: SLUDGE	25 COTTAGE ROAD, SOUTH PORTLAND, ME 04106-	(207)767-7675	20294	TYPE II
ST ONGE, ROBERT L	Active	LYMAN	COMPOSTING OF ORGANIC/VEGATIVE MATTER	100 NOT A ROAD, LYMAN, ME 04002-	(207)499-7886	29629	
STINSON CANNING COMPANY	Inactive	GOULDSBORO	WINDROW: FISH WASTE AND SAWDUST	ROUTE 186, PROSPECT HARBOR, ME 04669-	(207)963-7331	20416	

STONINGTON, TOWN OF	Active	STONINGTON	WINDROW: YARD WASTE	PO BOX 9, STONINGTON, ME 04681-	(207)367-2351	15270	TYPE IA
STRAW'S FARM	Active	NEWCASTLE	WINDROW PROCESS: FISH AND WOODWASTE	30 BRICK HILL ROAD, NEWCASTLE, ME 04553-	(207)882-6875	32938	
TRUE FARMS, INC.	Inactive	CHARLESTON	WINDROW: FOOD AND YARD WASTE	RR 1, BOX 4710, CHARLESTON, ME 04422-	(207)285-3604	15338	
UNIVERSITY OF MAINE - ORONO	Active	OLD TOWN	WINDROW: LEAF & YARD WASTE, CAFETERIA FOOD, MANURE	107 MAINE AVE, BANGOR, ME 04401-	(207)973-3336	29712	
VEAZIE, TOWN OF	Active	VEAZIE	WINDROW: LEAF AND YARD WASTE	1084 MAIN STREET, VEAZIE, ME 04401-	(207)947-2781	15199	TYPE IA
WALTER LAMONT JR	Active	MONTVILLE	WINDROW: SEA URCHIN PROCESSING WASTE	RR 2 BOX 475, SEARSMONT, ME 04973-	(207)342-4042	26365	
WASHINGTON COUNTY COMMISSIONERS & COAST OF MAINE INC	Active	MACHIAS	EXPANSION:WINDROW-BLUEBERRY, SALMON AND OTHER MARINE WASTES	PO BOX 279, MACHIAS, ME 04654-	(207)255-3127	30988	
WATERBORO, TOWN OF	Active	WATERBORO	WINDROW: LEAF AND YARD WASTE	PO BOX 130, WATERBORO, ME 04087-	(207)247-5166	15164	TYPE IA
WATERVILLE, CITY OF	Inactive	WATERVILLE	WINDROW: LEAF AND YARD WASTE	CITY HALL, 1 COMMON STREET, WATERVILLE, ME 04901-	(207)873-7131	14573	TYPE IA
WATERVILLE/WINSLOW, CITIES OF	Inactive	WINSLOW	WINDROW: LEAFE AND VEGETATIVE WASTE	6 WENTWORTH COURT, WATERVILLE, ME 04901-	(207)873-7131	14856	TYPE IA
WEBB, RONALD	Active	PITTSTON	WINDROW: MUSSEL WASTE UP TO 2,000 YD/YR	RR 2 BOX 73, GARDINER, ME 04345-	(207)582-5595	26674	
WHITE BUFFALO FOREST	Active	GOULDSBORO	WINDROW: FISH PROCESSING WASTE (SEA URCHINS,SEA CUCUMBERS)	BOX 42, SOUTH GOULDSBORO, ME 04678-	(207)963-7326	15485	
WILTON WWTP	Active	WILTON	STATIC AERATED PILE: SEWAGE SLUDGE	PO BOX 541, WILTON, ME 04294-0541	(207)645-3682	15422	
WINSLOW, ADDIE	Active	MAPLETON	WINDROW: LEAF AND YARD WASTE	254 CREASEY RIDGE ROAD, MAPLETON, ME 04757-	(207)764-1729	24403	TYPE IA
WOODWARD, CARL	Active	STONINGTON	WINDROW: CRAB WASTES	RFD #1, BOX 2778, STONINGTON, ME 04681-	(207)367-2605	15279	
WORCESTER ENERGY CO	Active	DEBLOIS	GENERAL TYPE I COMPOST LICENSE-OPEN WINDROW	HC 72 BOX 35-E, CHERRYFIELD, ME 04622-9602	(207)638-2811	29497	
YARMOUTH WWTP	Active	YARMOUTH	COMPOST SITE RENEWAL	200 MAIN STREET, YARMOUTH, ME 04096-	(207)846-2415	13517	
YARMOUTH, TOWN OF	Active	YARMOUTH	WINDROW: YARD WASTE	P.O. BOX 907, YARMOUTH, ME 04096-	(207)846-4971	15271	TYPE IA

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